8. OBSERVATIONS ON THE LOAD CARRIED BY THE SWAN RIVER DURING THE 1926 FLOOD.

(With One Plate VIII.)

By

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(*Read 13th November*, 1928. *Published 22nd April*, 1929.)

The following paper is presented in the hope that it may give some idea of the order of magnitude of the transporting work done by a river such as the Swan, during periods of exceptionally heavy rainfall. The actual figures obtained are, of course, only approximate, and no pretension to accuracy is made. We are much indebted to Associate-Professor Clarke and Miss L. V. Hosking for criticism and advice in the course of preparing the paper for publication, and to the Perth Branch of the Commonwealth Weather Bureau for information supplied regrading the rainfall.

The most severe flood experienced in the South-Western Districts of Western Australia since the early nineties was that lasting from the 19th to the 26th of July, 1926.* The coastal areas extending for roughly one hundred miles both north and south of Perth were subjected to considerable damage consequent upon the rise and overflow of the more important rivers. In many places the Swan River overflowed its banks and many of the residential areas near Perth were either wholly or partly inundated. In the higher reaches of the river much damage was done to small orchards situated along the inner banks. At Fremantle the washing away of the northern abutment of the railway bridge, causing the collapse of the two northern spans some few minutes after the passage of a train, was an event which helped to impress people with the unusual severity of the conditions.

The area drained by the Swan River, and its tributaries the Helena and the Canning, may be divided into two sections, rather sharply separated by the Darling Fault Scarp, namely:—

(1) The Darling Peneplain which rises about 950 feet above sea level, and is dissected near its western edge by youthful river valleys.

(2) The Swan Coastal Plain in which the valleys are mature.

The average annual rainfall in the area concerned is about thirty-five inches, most of it falling between the months of April and September. During that time the rivers east of the Darling Fault Scarp, attain their maximum. In the summer months, October to March, the rainfall is very small: the rivers east of the escarpment then become at most, slowly moving streams which are clear and carry little, if any, sediment. Most of the rivers cease to flow altogether.

* After this paper was read Mr. W. Catton Grasby kindly supplied the following note:—"I can find no definite records of high floods in the Swan; but the oldest residents agree that the highest flood since settlement occurred in 1872. After that there appears to have been a long period without very heavy floods. Mr. C. W. Harper tells me that there was a very high flood in 1904, and that it was considered to be the highest after 1872 to that date. Since that year floods have been common, the highest being in 1926, which was certainly higher than that of 1904, and old residents believe it to be the highest since 1872."

Flowing west and leaving the Darling Fault Scarp the rivers enter the Swan Coastal Plain, where they are broad, clear and practically without current, most of the water being in fact sea water. The Swan and Helena rivers join just below Guildford and thence form the drowned channel of the Swan River, which extends roughly from Perth to Fremantle and whose widest portion, Melville Water, is at the junction with the Canning River. Between Perth and Fremantle there is a comparatively narrow channel ranging in depth from ten to thirty feet, which is nearly everywhere flanked by extensive mud banks and sand spits, over which in normal seasons the depth of water is between six feet and a few inches. In winter the clear salt sea water is discoloured by muddy water flowing in from the higher reaches. This discoloration often reaches the river mouth but rarely extends more than a mile beyond it. Much of the sediment, carried in ordinary winter months, must, therefore, be deposited in the river itself and is no doubt responsible for many of the mud banks and sand spits.

During the 1926 flood a strong muddy stream flowed consistently seawards, discolouring the sea for a considerable area around the mouth. The unusually muddy nature of the river water, and the apparent broad zone over which the sediment was being desposited, suggested the probability that exceptional climatic conditions such as these were responsible for the greater part of the physiographic work done in this portion of the State, and that this was rather a unique opportunity for ascertaining the amount of material carried under such circumstances. A glance at the attached table, showing the rainfall for July and also the yearly rainfall for the years 1917 to 1926, will give some idea of the exceptional conditions. It will also be noticed that from the 18th to the 22nd of July, the rainfall at Perth, Mundaring and Chidlows was roughly an inch a day.

ANNUAL AND JULY RAINFALL AT SEVEN STATIONS IN THE SWAN BASIN FOR THE YEARS 1917 TO 1926.

——		1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	Average.	No. of years Record.
Perth ...	Year	4,564	3,958	3,066	4,035	4,109	3,186	4,447	3,379	3,141	4,922	3,437	52
	July	1,129	337	698	586	739	741	458	379	689	1,228	656	
Mundaring ...	Year	5,879	4,711	3,461	4,664	4,283	4,021	5,696	4,188	3,481	6,802	4,556	17
	July	1,389	320	722	694	849	1,084	575	620	842	1,667	879	
Chidlows ...	Year	5,511	3,723	2,931	3,453	3,409	3,436	5,281	3,738	3,207	5,816	3,676	20
	July	1,568	249	592	538	633	955	575	572	734	1,698	730	
Toodyay ...	Year	3,610	2,625	1,860	2,281	2,242	1,793	2,758	1,818	2,054	2,902	2,134	47
	July	1,012	175	460	319	374	672	297	268	403	825	428	
Northam ...	Year	2,776	2,000	1,399	1,937	1,991	1,718	2,314	1,377	1,797	2,267	1,710	46
	July	776	117	351	262	266	540	215	214	244	647	339	
York ...	Year	2,656	2,068	1,440	1,797	2,030	1,520	2,222	1,340	1,665	2,459	1,771	50
	July	672	109	295	268	315	468	169	208	241	830	335	
Beverley ...	Year	2,192	2,063	1,549	1,602	1,924	1,619	2,165	1,479	1,451	2,240	1,693	41
	July	535	126	294	219	355	511	177	231	254	651	324	

DAILY RAINFALL AT SEVEN STATIONS IN THE SWAN BASIN FOR THE PERIOD 16TH TO THE 31ST JULY, 1926.

(Falls for 24 hours ended at 8 a.m. on date against which they are entered.)

July, 1926	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Perth ...	76	38	102	111	112	80	11	13	...	...	90	3	18	8	95	12
Mundaring	34	15	220	...	315	150	62	...	...	...	122	10	74	20	110	25
Chidlows	65	26	81	183	241	132	83	7	...	...	102	17	81	15	106	18
Toodyay	19	11	42	45	111	92	55	5	...	...	27	...	50	2	76	10
Northam...	24	15	27	30	121	57	44	...	...	...	19	...	16	5	67	8
York ...	20	14	44	55	233	55	42	2	...	...	18	3	14	10	53	3
Beverley ...	28	8	33	38	177	45	15	4	...	...	17	4	6	8	48	2

In order to ascertain the load carried by the river, samples of the flood waters were taken at various points which are shown on the accompanying map. At the same time the velocity of the current at these points was determined by timing over a known distance a wood float thrown into the stream. The flood level was marked on some convenient object. By evaporation the load in suspension and solution per 100 c.c. was calculated for each sample. No estimate of floating matter or material rolled along the river bed could be made. Where it was possible to obtain cross sections of the river, the volume of water flowing at flood level was determined for the period 19th to 20th July. Knowing the volume and the load in suspension and solution per 100 c.c. it was possible to calculate the load carried during the week. In two places only could we obtain the volume: (a) at the Fremantle Traffic Bridge, (b) at a point on the Helena River, just below its junction with Piesse Brook, where samples were taken at two points about five chains apart and the rate of flow and cross section were determined for each point.

STATEMENT OF DATA FOR CALCULATION OF TOTAL LOAD OF SWAN AND HELENA RIVERS DURING THE PERIOD 19TH–26TH JULY, 1926.

Locality.	Sample.	Sediment gms. per 100 c.c.	Velocity feet per sec.	Area of cross sect. square ft.	19th–26th July, 1926.	
					Vol. cu. ft.	Total Load. Tons.
Fremantle Traffic Bridge	No. 6	·3004	13·7	6,117	50,500,000,000	863,000
Helena River ...	No. 1	·0277	3·4	596	1,250,000,000	7,550
Do. ...	No. 2	·0153	6·2	348		

With the samples taken at the Helena River the calculated volumes were, No. 1 : 2,169 cubic feet per second ; No. 2 : 2,029 cubic feet per second. These values being fairly close show that a fair approximation to the true rate of flow was obtained considering the roughness of the method. For the purpose of the calculation of the Helena load the average value of samples No. 1 and No. 2 was taken. Where it was possible samples were taken in duplicate and sometimes in triplicate, the values given for the load in grammes per 100 c.c. being the average values obtained, the total load for the Swan and the Helena was then calculated in tons.

In making the above calculations it was necessary to assume, that the velocity of the stream was constant throughout the week, that the flood level remained constant, and also that the load itself was constant.

In addition to the above, three further samples were taken. :—
No. 3 at a point in the Swan above the Swan-Helena junction.
No. 4 at the Perth Causeway.
No. 5 in the deep water channel at Crawley.

At these points it was impossible to obtain cross sections but a comparison of the load per 100 c.c. of the six samples is interesting.

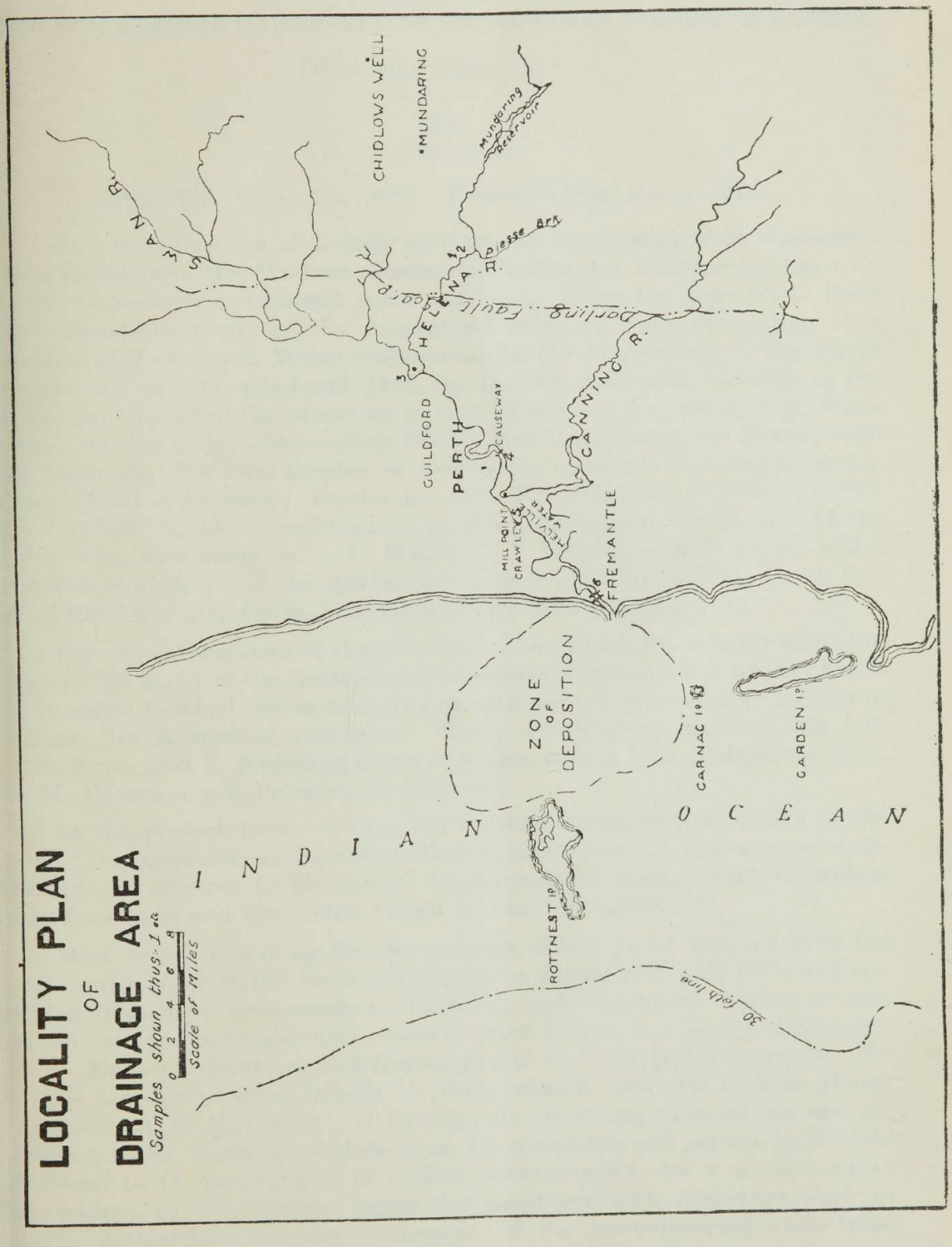
CALCULATED LOAD PER 100 C.C. IN PORTIONS OF THE SWAN AND HELENA RIVERS DURING THE PERIOD 19TH–26TH JULY, 1926.

Locality.	Mark on Map.	Number of Samples taken.	Average Value of Load in Grammes per 100 c.c.
Helena River	1 and 2	4	·0215
Swan	3	1	·1156
Causeway	4	2	·0798
Crawley Bay	5	3	·0982
Fremantle	6	3	·3004

From the above table it will be apparent that above its junction with the Helena, the Swan had a greater load per 100 c.c. than it had at the Causeway (c.f. samples No. 3 and No. 4), hence it appears that the Helena acted as a diluent. The relatively small amount of sediment carried by the Helena (samples No. 1 and No. 2) is explained by the filtering effect of the artificially drowned part of the Helena Valley at Mundaring Reservoir. Between the Causeway and Crawley the load increased, this may have been due to mud swept off the many banks existing between these localities. At Fremantle the load was three times that at Crawley, thus indicating that between these points much material had been swept from the mud banks and sand spits, and had been carried sea-wards. Owing to lack of facilities in the short period of duration of the flood, no samples were obtained from the Canning River and hence its effect on the Swan Load could not be determined.

Although the currents in the river channel kept the Fremantle Harbour effectively scoured, it was evident from the appearance of the sea off Fremantle, that on contact with the salt sea water, and with the lessening velocity of the freshwater stream, much of the sediment was deposited within ten miles of the river mouth. The zone over which the greater portion of the sediment appeared to have been deposited was judged roughly by the discoloration of the sea water, is shown on Plate VIII. and no doubt much of the finer sediment would be more widely spread, possibly reaching beyond the thirty fathom line.

PLATE VIII.



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